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The Contribution of Heavy-Duty Vehicles to the New York City Emission Inventory

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Lois Platte
February 1980

Office of Air, Noise, and Radiation
Office of Mobile Source Air Pollution Control
Motor Vehicle Emission Laboratory
Emission Control Technology Division
Technology Assessment and Evaluation Branch

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16. ABSTRACT

The EPA Administrator signed a regulation setting standards for hydrocarbons (HC) at 1.3 g/BHP-hr and carbon monoxide (CO) at 15.5 g/BHP-hr for 1984 and later model year heavy duty vehicles (HDV). The reduction in the total emission levels due to the introduction of these standards was estimated on a national level by combining the emission inventories of several regions. These regions represent most of the major metropolitan areas in the U.S. that have violations of the national ambient air quality standards (NAAQS) for ozone and CO.

This combined inventory may account for a large proportion of the total U.S. population subjected to the high pollutant levels, but it may not be the appropriate inventory for demonstrating the maximum emission reduction achievable through the introduction of the new standards. The inventory of an area characterized by a high traffic density with a large number of HDV should be examined to approximate the maximum reduction in total emissions that can be attributed to the new HDV standards. In an effort to approximate this maximum reduction, the HC and CO inventories for the New York City (NYC) area are examined in this report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Emission Standards Regulations Exhaust Gases Hydrocarbons Carbon Monoxide Urban Areas Air Pollution	Heavy Duty Vehicles New York City	

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Recently, the EPA Administrator signed a regulation setting standards for hydrocarbons (HC) at 1.3 g/BHP-hr and carbon monoxide (CO) at 15.5 g/BHP-hr for 1984 and later model year heavy duty vehicles (HDV). The benefit of the new standards was evaluated in the supporting regulatory analysis (Reference 1). The reduction in the total emission levels due to the introduction of these standards was estimated on a national level by combining the emission inventories of several regions. These regions represent most of the major metropolitan areas in the U.S. that have violations of the national ambient air quality standards (NAAQS) for ozone and CO.

This combined inventory may account for a large proportion of the total U.S. population subjected to the high pollutant levels, but it may not be the appropriate inventory for demonstrating the maximum emission reduction achievable through the introduction of the new standards. The inventory of an area characterized by a high traffic density with a large number of HDV should be examined to approximate the maximum reduction in total emissions that can be attributed to the new HDV standards. In an effort to approximate this maximum reduction, the HC and CO inventories for the New York City (NYC) area are examined in this report.

The emission inventories for the New York area that are reported in this paper have been provided by the City of New York Department of Environmental Protection. The mobile source portion of these inventories are based on the Mobile Source Emission Factors document (Reference 2). The NYC inventories were developed using the worst case ambient temperature conditions that are thought to represent the periods with the highest frequency of violations of the NAAQS in NYC. Specifically, the mobile source inventories were calculated assuming an ambient temperature of 70^{o}F for HC and 30^{o}F for CO. The vehicle miles traveled (VMT) values used in the NYC inventories are the same as those used in the development of the 1979 State Implementation Plans (Reference 3). All the information provided by the New York Department of Environmental Protection is given in the Appendix of this paper.

The NYC emission inventories include Manhattan and the counties of Kings, Queens, Richmond, and Bronx. The city wide, 24 hour HC and CO emission inventories for calendar year 1976 are summarized in Table 1. In 1976, HDVs accounted for approximately 5% of the total VMT in NYC. The HDVs contributed approximately 18% of the HC emissions and 16% of the CO emissions from mobile sources in 1976. Relative to all emission sources, the HDVs accounted for about 10% of the HC and 15% of the CO in that same year.

Table 2 presents the corresponding inventories from the HDV regulatory analysis for comparison to the NYC inventories. There are several differences, besides the areas represented, in the way the two sets of inventories were developed. These differences are listed in Table 3. A

direct comparison of the absolute emission levels between the two inventories is not recommended because of these differences. The effect of these differences is that the NYC area inventories represent situations which are close to the worst case. The regulatory analysis inventories represent conditions that are average or most typical for the nation as a whole. A comparison of the percent of emissions due to HDVs between the NYC and regulatory analysis inventories is appropriate, if the differences are kept in mind.

For the national inventory given in the regulatory analysis, the HDVs account for 12% of the non-methane hydrocarbons (NMHC) and 15% of the CO attributable to mobile sources. Approximately 4% of the NMHC and 13% of the CO from all emission sources is attributable to the HDVs.

Comparison of Tables 1 and 2 indicates that HDVs account for a greater percentage of the HC emission inventory in NYC than on the national level. The percent of CO due to HDVs is similiar in both inventories. This may be due in part to the fact that these CO inventories represent a large area. HDVs may account for a greater percentage of the CO inventory in a smaller local area, since CO is often a localized problem. CO inventories have been developed by the City of New York Department of Environmental Protection for the congested central business districts (CBD) of Manhattan. The Manhattan inventories will be examined to determine whether the HDVs contribute to the total inventory at a greater percentage in the Manhattan CBDs than in NYC as a whole.

Two areas of Manhattan are defined as CBDs. They are referred to as downtown Manhattan and midtown Manhattan. The midtown area is bounded by 30th and 60th Streets (midtown runs river to river). During business hours, 7% of the total VMT in the midtown area is attributable to heavy duty trucks and approximately 3% of the total VMT is due to buses. The downtown area runs from Canal Street to the Battery. Approximately 10% of the total VMT is due to HDVs in downtown Manhattan during business hours. Buses account for 1.5% of the HDV VMT in downtown Manhattan during business hours.

Table 4 presents a summary of the CO inventory for both these Manhattan districts for the business period of 7AM - 6PM. Stationary source CO is not included in the CBD inventories because the overwhelming proportion of CO is due to mobile sources.

The HDV contribution to the CO levels in these CBDs represents 30% in midtown Manhattan and 34% in the downtown area for 1976. Thus, HDVs contribute significantly more CO to the total CO emission inventory in these high traffic density areas than in NYC as a whole or in the national inventory given the HDV regulatory analysis.

To illustrate, the future impact of the HDV regulations on the NYC areas, the NYC and Manhattan inventories for mobile sources were projected for 1990. The VMT growth rates and the ratios of 1990 to 1976 emission factors that were used in the calculation of the future year inventories

in the HDV regulatory analysis were applied to the NYC and Manhattan inventories. The projected 1990 mobile source inventories for the NYC areas are given in Table 5.

One measure of the benefit of the HDV regulations in 1990 is the percent difference in the total emissions between a case of no further HDV regulations beyond what is currently in existence and the case of the newly imposed HDV regulations. The percent differences in total emissions for these two cases are given in Table 6 for all the investigated NYC areas and the combined areas used in the regulatory analysis.

These statistics illustrate that the impact of the HDV standards in reducing the total HC and CO emissions burden can be greater than that demonstrated in the regulatory analysis. Specifically, the CBD Manhattan areas with their high traffic density and large number of HDVs represent areas where the regulations have the potential for greater emission reductions.

Table 1

HC, CO Emission Inventory
Tons/Day
All New York City
Calendar Year 1976

	Source			
Pollutant	HDG	HDD	Total Mobile	Total Sources*
HC	58.13	3.64	349.74	643.59
CO	535.30	29.59	3592.03	3803.42

HDV Emissions as Percent of Total Emissions
All New York City
Calendar Year 1976

Pollutant	HDV/Total Mobile	HDV/Total Sources*
HC	17.7%	9.6%
CO	15.7%	14.9%

*The total emissions from all sources for 1976 were not available. The values in the table were estimated using a ratio of total mobile source emissions to total emissions from all sources for the calendar year 1975. See page 1 of the Appendix for the 1975 values.

Table 2

NMHC, CO Emission Inventory
1000 Tons/Year
HDV Regulatory Analysis
Calendar Year 1976

	Source			
Pollutant	HDG	HDD	Total Mobile	Total Sources
NMHC	424.0	98.0	4398.0	13267
CO	2340.0	109.0	16223.0	19330

HDV Emissions as Percent of Total Emissions
HDV Regulatory Analysis
Calendar Year 1976

Pollutant	HDV/Total Mobile	HDV/Total Sources
NMHC	11.9%	3.9%
CO	15.1%	12.7%

Table 3

Differences in Assumptions
Used to Calculate 1976 Calendar Year Inventories

	Manhattan/NYC Inventory	HDV Regulatory Analysis Inventory
Hydrocarbons	Total HC	Non-methane HC
Ambient Temperature	HC - 70°F CO - 30°F	NMHC - 75°F CO - 75°F
Average Speed	Dependent on area NYC ~19.6 mph Midtown ~6.5 mph Downtown ~12.9 mph	19.6 mph
Mobile Source EFs	MOBILE1 for all categories except taxis, deterioration higher than light duty auto	Taxi deterioration equivalent to light duty auto
Inventory Time Period	NYC - 24 hours CBDs - 7 AM - 6 PM	24 hours

Table 4

CO Emission Inventory
Tons/Day - Business Hours
Midtown, Downtown Manhattan
Calendar Year 1976

	Source		
Area	HDG	HDD	Total Mobile
Midtown	38.99	2.62	139.56
Downtown	12.43	0.61	38.85

HDV Emissions as Percent of Total Emissions
Midtown, Downtown Manhattan
Calendar Year 1976

Area	HDV/Total Mobile
Midtown	29.8%
Downtown	33.6%

Table 5

Projected HC, CO Emission Inventory - Assuming 1984 HDV Standards
Tons/Day
NYC, CBDs of Manhattan
Calendar Year 1990*

Pollutant, Area	Source		
	HDG	HDD	Total Mobile
HC, NYC	12.64	5.22	75.46
CO, NYC	168.62	60.66	805.56
CO, Midtown	12.28	5.37	36.43
CO, Downtown	3.81	1.17	9.41

Projected HC, CO Emission Inventory
Assuming No Further HDV Standards
Tons/Day
NYC, CBDs of Manhattan
Calendar Year 1990*

Pollutant, Area	Source		
	HDG	HDD	Total Mobile
HC, NYC	22.24	7.46	87.30
CO, NYC	413.52	60.66	1050.46
CO, Midtown	30.12	5.37	54.27
CO, Downtown	9.35	1.17	14.95

*Inventory was projected using VMT growth rates and emission factor ratios from the HDV regulatory analysis. All taxi types were combined with light duty autos.

Table 6

Impact of 1984 HDV Regulations
on Projected Total Emissions
from Mobile Sources

Pollutant	Area	Emission Reduction (%) Due to 1984 HDV Regulations*
HC	NYC	13.6%
CO	NYC	23.3%
CO	Midtown Manhattan	32.9%
CO	Downtown Manhattan	37.1%

Regulatory Analysis

Pollutant	Emission Reduction (%) Due to 1984 HDV Regulations*
NMHC	11.3%
CO	22.7%

*Impact is defined as: $(E_{\text{No Stnd}} - E_{\text{Stnd}})/E_{\text{No Stnd}} \times 100$

where $E_{\text{No Stnd}}$ is the projected 1980 mobile source emission inventory assuming no new HDV standards are established.

and E_{Stnd} is the projected 1990 mobile source emission inventory assuming the new HDV standards are in effect.

APPENDIX

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

EMISSIONS INVENTORY SUMMARY 1975

In Tons per Year

SOURCE	SO_2	PART.	NO_x	HC	CO
SPACE HEATING	37,743	5,969	53,087	1,502	13,772
INCINERATION					
MUNICIPAL	1,622	8,871	1,946	974	22,713
ON SITE	240	5,579	8,241	2,472	8,241
TRANSPORTATION					
MOTOR VEHICLE	2,400	7,580	68,000	116,452	1,062,000
AIRCRAFT	507	310	5091	6,185	12,270
INDUSTRIAL PROC. PWR. & STEAM GEN.					
PWR. LILCO	520	70	1,350	12	62
CON-ED	40,299	5,608	69,209	966	5,137
MNFG.	149	820	121	10,556	302
SOLVENT EVAPORATION INDUSTRY SPRAYING AND COATING				14,788	
OTHER USES OF SOLVENTS				38,180	
GASOLINE STR & MKT				22,140	
TOTAL	83,480	34,807	207,045	214,227	1,124,497

9/25/78

MOBILE SOURCE EMISSIONS PROJECTIONS FOR ALL NEW YORK CITY

HYDROCARBONS
(TONS/DAY) 24 HOUR

NEW CAR EMISSION STANDARD TIMETABLE NO. 3: 1977 CLEAN AIR ACT AMMENDMENTS

AMBIENT TEMP. = 70.00 TRAFFIC DATA BASE: NYC73A24

TT	TEMP	YEAR	AUTOS	TAX-FM	TX-NFM	TAX-NM	LDGT	HDGT	DIESEL	ALL MODES	TOTAL VMT
3	70.F	1973	288.69	14.24	4.36	11.22	25.14	64.84	3.58	412.07	VMT = 38242960.
3	70.F	1974	274.31	14.43	4.27	10.72	23.99	61.37	3.60	392.67	VMT = 38409232.
3	70.F	1975	258.11	13.38	4.12	10.30	22.83	59.69	3.62	372.05	VMT = 38575472.
3	70.F	1976	242.08	10.79	3.75	9.52	21.84	58.13	3.64	349.74	VMT = 38741760.
3	70.F	1977	224.55	7.52	3.16	8.41	21.06	57.56	3.66	325.91	VMT = 38907984.
3	70.F	1978	205.77	6.89	2.40	7.12	20.26	57.12	3.67	303.22	VMT = 39074224.
3	70.F	1979	186.37	6.23	2.10	6.35	19.15	54.96	3.73	278.89	VMT = 39240496.
3	70.F	1980	162.88	4.93	1.77	5.43	17.25	49.30	3.81	245.37	VMT = 39406768.
3	70.F	1981	140.07	3.70	1.38	4.30	15.81	44.24	3.89	213.39	VMT = 39572992.
3	70.F	1982	118.65	2.40	1.05	3.45	14.57	38.25	3.96	182.33	VMT = 39739296.
3	70.F	1983	101.28	2.36	0.75	2.66	13.43	34.36	3.86	158.69	VMT = 39905536.
3	70.F	1984	86.60	2.36	0.68	2.31	12.18	30.41	3.63	138.17	VMT = 40071776.
3	70.F	1985	74.12	2.36	0.66	2.09	10.99	26.94	3.41	120.57	VMT = 40238048.
3	70.F	1986	65.07	2.36	0.64	1.88	9.99	25.39	3.21	108.55	VMT = 40404288.
3	70.F	1987	56.72	2.37	0.64	1.78	9.07	23.66	3.08	97.32	VMT = 40570560.
3	70.F	1988	53.06	2.37	0.64	1.72	8.28	22.43	2.97	91.46	VMT = 40736800.
3	70.F	1989	50.37	2.37	0.64	1.70	7.52	21.59	2.88	87.07	VMT = 40903088.
3	70.F	1990	48.16	2.37	0.64	1.70	6.95	21.04	2.82	83.70	VMT = 41069312.

MOBILE SOURCE EMISSIONS PROJECTIONS FOR ALL NEW YORK CITY

CARBON MONOXIDE
(TONS/DAY) 24 HOUR

--------NEW CAR EMISSION STANDARD TIMETABLE NO. 3: 1977 CLEAN AIR ACT AMMENDMENTS

----------AMBIENT TEMP. = 30.00 TRAFFIC DATA BASE: NYC73A24

TT	TEMP	YEAR	AUTOS	TAX-FM	TX-NFM	TAX-NM	LDGT	HDGT	DIESEL	ALL MODES	TOTAL VMT
3	30.F	1973	2717.59	156.29	45.68	103.78	252.67	567.56	33.58	3877.15	VMT = 38242960.
3	30.F	1974	2695.38	156.02	45.33	104.20	250.12	556.23	32.70	3839.97	VMT = 38609232.
3	30.F	1975	2643.54	141.49	43.27	102.27	245.89	545.15	31.10	3752.72	VMT = 38575472.
3	30.F	1976	2544.06	109.85	38.55	95.10	239.59	535.30	29.59	3592.03	VMT = 38741760.
3	30.F	1977	2419.55	69.41	31.26	83.14	235.67	529.27	28.26	3396.57	VMT = 38907984.
3	30.F	1978	2301.87	68.21	22.98	69.54	232.44	524.48	27.37	3246.87	VMT = 39074224.
3	30.F	1979	2186.19	68.07	21.04	63.75	227.93	515.63	26.85	3109.47	VMT = 39240496.
3	30.F	1980	2007.01	58.63	18.95	56.74	221.84	498.02	26.60	2887.79	VMT = 39406768.
3	30.F	1981	1758.22	42.05	15.73	46.49	215.40	482.65	26.52	2587.06	VMT = 39572992.
3	30.F	1982	1503.13	22.84	11.62	36.73	210.88	467.02	26.56	2278.78	VMT = 39739296.
3	30.F	1983	1296.69	20.26	7.32	27.12	202.78	440.06	26.59	2020.83	VMT = 39905536.
3	30.F	1984	1116.16	20.13	6.02	22.85	186.62	386.31	26.65	1764.75	VMT = 40071776.
3	30.F	1985	955.51	20.14	5.63	20.11	170.01	330.04	26.75	1536.20	VMT = 40238048.
3	30.F	1986	824.43	20.16	5.45	17.35	154.41	298.85	26.59	1347.24	VMT = 40404288.
3	30.F	1987	702.70	20.17	5.39	15.90	139.91	267.89	26.71	1178.68	VMT = 40570560.
3	30.F	1988	642.26	20.19	5.38	14.91	126.62	242.19	26.81	1078.36	VMT = 40736800.
3	30.F	1989	594.18	20.21	5.38	14.51	112.94	219.43	26.90	993.55	VMT = 40903088.
3	30.F	1990	557.95	20.22	5.39	14.51	104.10	205.86	26.98	935.01	VMT = 41069312.

N. Y. C. DEPT. OF ENVIRONMENTAL PROTECTION / NOVEMBER 8, 1978

MOBILE SOURCE EMISSIONS PROJECTIONS FOR MANHATTAN MIDTOWN

CARBON MONOXIDE
(TONS/DAY) 7AM - 5PM

--------NEW CAR EMISSION STANDARD TIMETABLE NO. 3: 1977 CLEAN AIR ACT AMMENDMENTS

----------AMBIENT TEMP. = 30.00

TRAFFIC DATA BASE: MVS245

TT	TEMP	YEAR	AUTOS	TAX-FM	TX-NFM	TAX-NM	LDGT	HDGT	DIESEL	ALL MODES	TOTAL VMT
3	30.F	1973	58.82	37.90	11.15	1.38	10.04	43.30	3.06	165.65	VMT = 668634.
3	30.F	1974	58.85	37.99	11.02	1.38	9.96	42.01	2.96	164.17	VMT = 668634.
3	30.F	1975	56.66	34.54	10.50	1.32	9.79	40.44	2.79	155.85	VMT = 668634.
3	30.F	1976	51.96	26.04	9.31	1.18	9.45	38.99	2.62	139.56	VMT = 668634.
3	30.F	1977	46.54	19.22	7.37	0.95	9.18	37.92	2.48	119.66	VMT = 668634.
3	30.F	1978	42.33	14.88	5.16	0.75	8.93	36.99	2.38	111.41	VMT = 668634.
3	30.F	1979	39.19	14.83	4.64	0.68	8.53	35.60	2.33	105.90	VMT = 668634.
3	30.F	1980	33.84	12.76	4.15	0.59	8.24	33.17	2.32	95.08	VMT = 668634.
3	30.F	1981	27.26	9.15	3.43	0.46	7.86	31.35	2.33	81.54	VMT = 668634.
3	30.F	1982	21.27	4.96	2.53	0.34	7.52	28.96	2.35	67.92	VMT = 668634.
3	30.F	1983	17.22	4.40	1.59	0.24	7.09	26.54	2.36	59.44	VMT = 668634.
3	30.F	1984	14.40	4.37	1.31	0.21	6.45	22.87	2.36	51.96	VMT = 668634.
3	30.F	1985	12.23	4.37	1.22	0.18	5.82	19.56	2.38	45.76	VMT = 668634.
3	30.F	1986	10.42	4.37	1.18	0.16	5.23	16.82	2.36	40.54	VMT = 668634.
3	30.F	1987	9.02	4.37	1.17	0.16	4.64	14.93	2.37	36.55	VMT = 668634.
3	30.F	1988	8.43	4.37	1.16	0.15	4.15	13.17	2.37	33.81	VMT = 668634.
3	30.F	1989	8.04	4.37	1.16	0.15	3.67	11.72	2.38	31.49	VMT = 668634.
3	30.F	1990	7.79	4.37	1.16	0.15	3.34	10.32	2.38	30.01	VMT = 668634.

N. Y. C. DEPT. OF ENVIRONMENTAL PROTECTION / NOVEMBER 8, 1978

MOBILE SOURCE EMISSIONS PROJECTIONS FOR MANHATTAN DOWNTOWN

CARBON MONOXIDE
(TONS/DAY) 7AM - 6PM

NEW CAR EMISSION STANDARD TIMETABLE NO. 3: 1977 CLEAN AIR ACT AMMENDMENTS

AMBIENT TEMP. = 30.00 TRAFFIC DATA BASE: MVS245

FT	TEMP	YEAR	AUTOS	TAX-FM	TX-NFM	TAX-NM	LDGT	HDGT	DIESEL	ALL MODES	TOTAL VMT
3	30.F	1973	21.91	1.76	0.52	0.27	3.37	13.76	0.71	43.95	VMT = 192126.
3	30.F	1974	23.92	1.76	0.51	0.23	3.05	13.36	0.68	43.51	VMT = 192126.
3	30.F	1975	22.93	1.60	0.49	0.22	3.00	12.84	0.64	41.76	VMT = 192126.
3	30.F	1976	21.07	1.22	0.43	0.20	2.89	12.43	0.61	38.85	VMT = 192126.
3	30.F	1977	19.93	0.72	0.34	0.16	2.91	12.11	0.57	35.55	VMT = 192126.
3	30.F	1978	17.09	0.71	0.24	0.13	2.73	11.82	0.55	33.27	VMT = 192126.
3	30.F	1979	15.79	0.70	0.22	0.12	2.64	11.40	0.54	31.41	VMT = 192126.
3	30.F	1980	13.63	0.61	0.20	0.10	2.52	10.66	0.54	28.25	VMT = 192126.
3	30.F	1981	10.97	0.43	0.16	0.08	2.40	10.01	0.54	24.60	VMT = 192126.
3	30.F	1982	8.55	0.24	0.12	0.06	2.30	9.37	0.54	21.18	VMT = 192126.
3	30.F	1983	6.91	0.21	0.08	0.04	2.16	8.61	0.54	18.56	VMT = 192126.
3	30.F	1984	5.76	0.21	0.06	0.04	1.97	7.43	0.55	16.02	VMT = 192126.
3	30.F	1985	4.98	0.21	0.05	0.03	1.78	6.37	0.55	13.88	VMT = 192126.
3	30.F	1986	4.13	0.21	0.06	0.03	1.69	5.50	0.55	12.07	VMT = 192126.
3	30.F	1987	3.56	0.21	0.06	0.03	1.62	4.85	0.55	10.67	VMT = 192126.
3	30.F	1988	3.12	0.21	0.06	0.03	1.27	4.32	0.55	9.75	VMT = 192126.
3	30.F	1989	3.16	0.21	0.06	0.03	1.12	3.85	0.55	8.97	VMT = 192126.
3	30.F	1990	3.06	0.21	0.06	0.03	1.02	3.56	0.55	8.48	VMT = 192126.

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